(19) Japanese Patent Office (JP)

(12) Publication of Unexamined Patent Application (A)

(11) Unexamined Patent Application No.

H01-141707

(51) Int. Cl.[4]		Identification Symbol	JPO File Number	(43) Publication Date: 2 June 1989
B 29 C	33/44		8415-4F	
B 25 J	18/00		8611-3F	
B 29 C	45/42		6949-4F	
// B 29 K	105:20			

Examination Request: Not yet made/ Number of Inventions: 1 (Total of 7 pages)

(54) Title of the Invention: Insertion Robot

(21) Application No: S62-299768

(22) Application Date: 20 November 1987

(72) Inventor Kazumitsu TAKAI
Pentel Co., Ltd.
Kusaka Plant
4-1-8 Yoshimachi, Kusaka-shi, Saitama-ken

(71) Applicant Pentel Co., Ltd.
7-2 Koami-cho, Nihonbashi, Chuo-ku, Tokyo

(74) Agent Sadao ITOH, Patent Attorney,

SPECIFICATION

1. Title of the Invention

Insertion Robot

2. Claims

An insertion robot comprising a gripper for removing a product formed from a die and a gripper for gripping an insertion workpiece that is inserted into the die, both provided on the ends of arms, wherein said robot advances the aforementioned grippers into the molding machine and performs this operation using two separate actuators that operate to position the grippers so that the center of the gripper at the end of the arm and the center of the die are both aligned from the retracted position of the stroke of one of the actuators and the center of the gripper at the base of the arm and the center of the die are both aligned from the same retracted position of the stroke of the other actuator.

3. Detailed Explanation of the Invention

(Industrial Field of Application)

The present invention relates to an insertion robot that loads a workpiece into a processing machine such as a molding machine and then removes the processed product.

(Prior Art)

In prior art robots that inserted workpieces into a die installed in a molding machine and removed the molded product , the insertion tool and removal tool provided on the end of the arm[s] were installed so that they formed a straight line in the direction in which the workpiece was advanced into the molding machine.

(Problems the Invention is to Solve)

In the aforementioned prior art, however, two advancing end positions were required in the insertion direction so a multipoint positioning method using a servomotor or a movable stopper method was employed.

However, the problem with the method that utilized a motor was that not only did the cost of the device increase, but the working speed got slower and the problem with the method that utilized a movable stopper was that after the stopper stopped in the center position, the stroke first needed to be retracted in order to release the stopper and advance it forward, which resulted in a loss of working time.

(Means for Solving the Problems)

An object of the present invention is to solve the aforementioned problems by providing an insertion robot comprising one gripper for removing a product formed from a die and another gripper for gripping an insertion workpiece that is inserted into the die, both provided on the ends of arms, wherein said robot advances the

aforementioned grippers into the molding machine and performs this operation using two separate actuators that operate to position the grippers so that the center of the gripper at the end of the arm and the center of the die are both aligned from the retracted position of the stroke of one of the actuators and the center of the gripper at the base of the arm and the center of the die are both aligned from the same retracted position of the stroke of the other actuator.

The following is a detailed explanation of the working examples shown in the drawings. Affixed to the top of mounting base 1 is Y_1 axis base 3 provided with a guide 2 in the mold opening direction and a guide 2 in the perpendicular direction in relation to the molding machine. X_1 axis base 4 is slidably attached to guides 2. On X_1 axis base 4 are provided guides 5, which are perpendicular to guides 2. Z-axis base 7 is slidably attached to guides 5 via spacer 6. On Z-axis base 7 are provided guides 8, which are perpendicular to guides 2 and guides 5. Slide base 10 is slidably attached to guides 8. Arms 11 and 11' are affixed to slide base 10 on the side at which the molding machine is positioned so that they are parallel to guides 2. Block 12 is affixed to the end of arms 11 and 11'. Arms 11 and 11' are hollow and guide rods 14 and 14' are slidably supported on the inside of these arms by sliding bearings 13 and 13' so that the guide rods are parallel to the arms. Tool base 15 is affixed to 14a and 14a', which are the ends of guide rods 14 and 14'. In addition, connected to tool base 15 is rod 16a of air cylinder 16, which is attached to block 12 so that it is parallel to arms 11 and 11'. Y_2 axis is the sliding axis for air cylinder 16. Affixed to tool base 15 is tool 15', which is equipped with insertion workpiece holder 17. 18 and 18' are the holes that mate with the positioning pins that are provided in the die.

Guide rod 14' protrudes out in front of tool base 15. Axially supported on protruding member 19 is rotating plate 20 that rotates freely around the center axis of guide rod 14'. Attached to rotating plate 20 is rotary actuator 21. Affixed to the output axis of the rotary actuator is gear 22, which engages with gear 23 that is affixed to the aforementioned protruding member.

Meanwhile, removal hand 24 is provided on rotating plate 20 so that it slides in a perpendicular direction in relation to aforementioned arms 11 and 11' by means of air cylinder 25, which is also provided on rotating plate 20, so that the center of the hand is positioned in a distance from mating hole 18' that is equal to half of the pitch P (= P/2) of the two mating holes 18 and 18'. X_2 axis is the sliding axis for air cylinder 25.

Based on the direction in which FIG. 4 is viewed, spacer 6 is shaped so that its top and bottom attachment surfaces are misaligned so that Z-axis base 7 overhangs to the right. Figure 26 is a conveyor that is positioned so that one end is facing downward from slide base 10 and Z-axis base 7. Figure 27 is the escape apparatus and figure 28 is the part feeder that supplies the insertion workpiece.

In addition, spacer 6 can be assembled as desired so that even if conveyor 26 is placed on the left side instead of on the right side, as shown in FIG. 4, in relation to the robot, conveyor 26 can still be positioned beneath slide base 10 and Z-axis base 7 (FIG. 5).

In addition, the stroke of air cylinder 16 is placed so as to be in the same position as the center distance between removal hand 24 and tool 15'.

A rodless air cylinder (not shown in the drawing) that is controlled by means of ON/OFF switching is used for the drive for the Y_1 axis. An air cylinder is also used for the drive for the Y_2 axis, which is also controlled via ON/OFF switching, but both the Y_1 and Y_2 axes are equipped with adjustable affixment stoppers (not shown in the drawing) at their stroke ends to allow for fine tuning of their positions.

A well-known straight-line drive means can be used for the drive for the X_1 axis and Z axis, such as an air cylinder, motor and ball thread or a rack/pinion combination. Of these methods, an air cylinder is inferior in terms of performing multipoint positioning, but is superior in terms of cost and working speed.

Next is provided an explanation of the operation of the present invention.

For FIG. 6 through FIG. 11, 29 is a horizontal injection molding machine, 30 is the die located on the side at which the insertion workpiece is inserted and the product is removed, 30' is the other die that faces 30, 31 and 31' are tie bars for the molding machine, 32 and 32' are positioning pins provided on die 30 and their pitch is represented by the letter P.

First, the robot drives the X_1 axis and the insertion workpiece (not shown in the drawing) that is detached from escape 27 is gripped by tool 15'. At this point, the Y_1 and Y_2 axes are both positioned at the retracted end, as shown in FIG. 6.

Next, the Y_1 axis is operated and when it reaches the advanced end, removal hand 24 is positioned to line up with the center of die 30. Then, the X_1 and X_2 axes are operated so that pin 32 on die 30 mates with mating hole 18' on tool 15' while removal hand 24 advances forward to a position where it can grip sprue 33 that protrudes from the front of die 30, as shown in FIG. 7.

After removal hand 24 grips sprue 33, the X_1 and X_2 axes are retracted, as shown in FIG. 8. The number 34 represents the product produced by the molding machine.

Next, air cylinder 16 is operated and the Y_2 axis is advanced forward. The stroke of air cylinder 16 is the same as the pitch P of the two positioning pins, 32 and 32', so the center of die 30 and tool 15' are aligned at the advanced end of the Y_2 axis, and the axial center of pins 32 and 32' and mating holes 18 and 18' also align, as shown in FIG. 9.

Next, the X_1 axis is advanced and mating holes 18 and 18' on tool 15' are mated with positioning pins 32 and 32' on die 30, as shown in FIG. 10. When this takes place, tool 15' inserts the insertion workpiece into the cavity inside of die 30 by means of an apparatus not shown in the drawing.

After the insertion workpiece is inserted into the cavity, the X_2 axis is retracted followed by the Y_1 and Y_2 axes. Once these axes have reached the retracted end, rotary actuator 21 is operated and the product 34 that is gripped by removal hand 24 is rotated 90 degrees together with rotating plate 20 so that it faces conveyor 26 that is positioned to face downward from removal hand 24, as shown in FIG. 11, the Z axis is lowered, product 34 is positioned just above conveyor 26, removal hand 24 is released and product 34 is transferred onto conveyor 26.

(Effects of the Invention)

The present invention employs a robot comprising one gripper for removing a product formed from a die and another gripper for gripping an insertion workpiece that is inserted into the die, both provided on the ends of arms, wherein said robot advances the aforementioned grippers into the molding machine and performs this operation using two separate actuators that operate to position the grippers so that the center of the gripper at the end of the arm and the center of the die are both aligned from the retracted position of the stroke of one of the actuators and the center of the gripper at the base of the arm and the center of the die are both aligned from the same retracted position of the stroke of the other actuator, so as to allow for an inexpensive configuration as well as the ability to achieve strokes that correspond to two different grippers resulting in the ability to increase the working speed.

According to the configuration of the present invention, the stroke is long, but because this invention employs a large, rigid rail-type slide guide that has a short stroke to guide the Y_1 axis, which is at a distance from the tool, and a less rigid shaft-type guide that can easily be made more lightweight to guide the Y_2 axis, which is closer to the tool, the overall dimensions in the direction of the Y axis can be shortened without decreasing the rigidity at the end of the tool, resulting in the need for less space.

Furthermore, guide shafts 14 and 14' at the Y_2 axis are positioned on the same axis in the hollow portions inside of arms 11 and 11', allowing for a thinner, more compact width at the end of the arm, so even if the mold opening of the die is small, the possibility of interference is minimal.

4. Brief Explanation of the Drawings

FIG. 1 is a perspective view of a working example of the present invention. FIG. 2 is a front view of a partial cutaway diagram of the end of the arm shown in FIG. 1. FIG. 3 is a right side view of the rotating plate shown in FIG. 2. FIG. 4 is a left side view of the overall system of the present invention shown in FIG. 1. FIG. 5 is a modified perspective view of FIG. 4. FIG. 6 through FIG. 11 are explanatory diagrams of the top view of the present invention that show the various steps of its operation.

1 ... Mounting base
2, 5 ,8 ... Guides
3 ... Y_2 axis base
4 ... X_1 axis base
7 ... Z-axis base
10 ... Slide base
11, 11' ... Arms
14, 14' ... Guide rods
15 ... Tool base
15' ... Tool
16 ... Air cylinder
17 ... Insertion workpiece holder
18, 18' ... Mating holes for the positioning pins
30, 30' ... dies
32, 32' ... Positioning pins on the dies

Patent Applicant: Pentel Co., Ltd.
Agent: Sadao ITOH

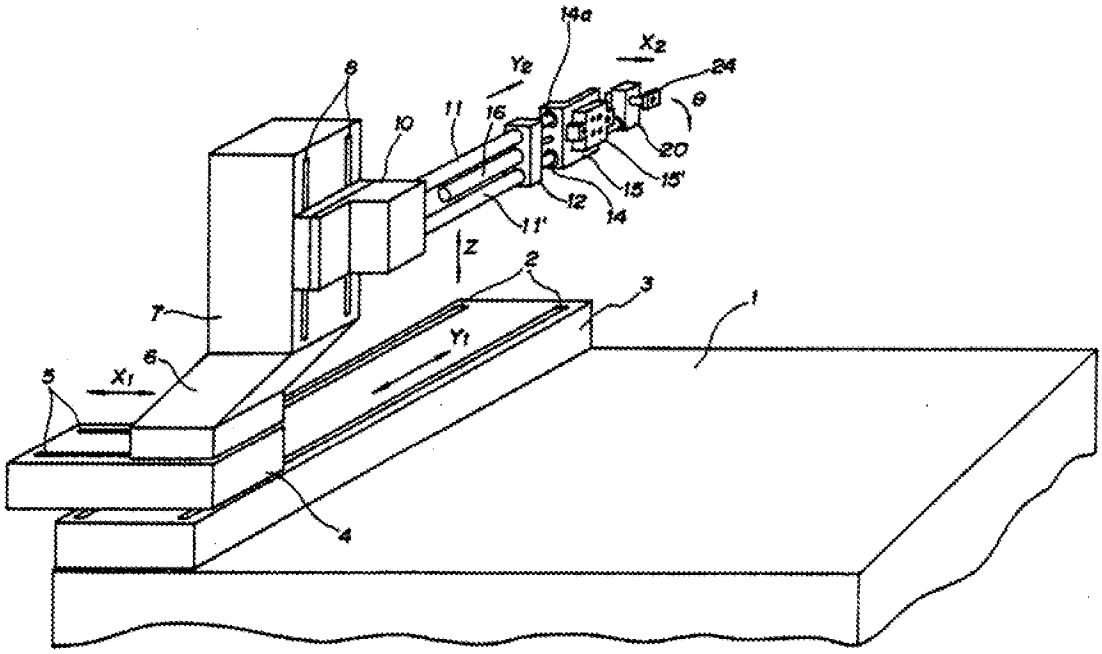

FIG. 1

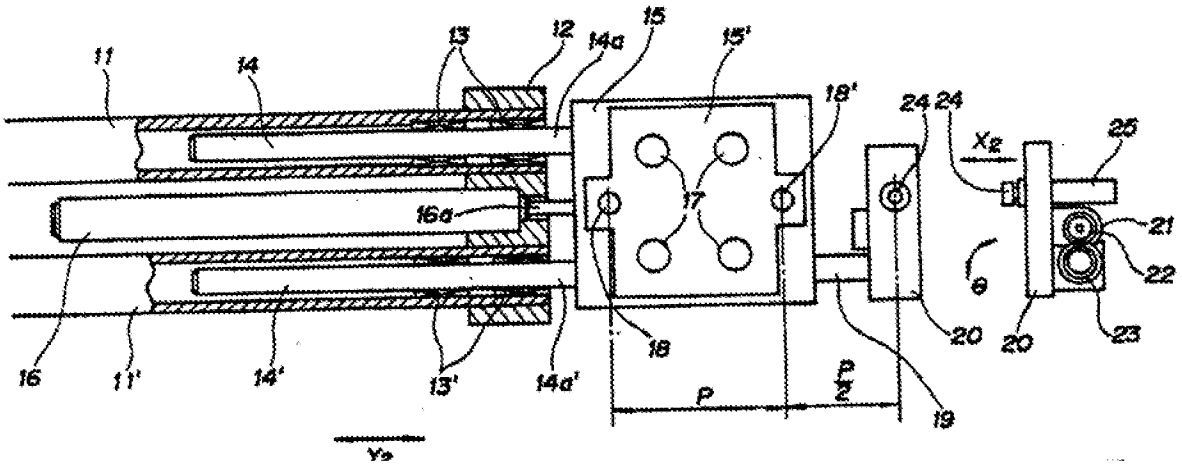

FIG. 2

FIG. 3

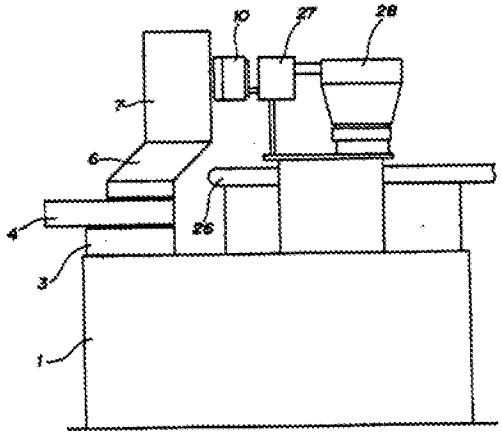

FIG. 4

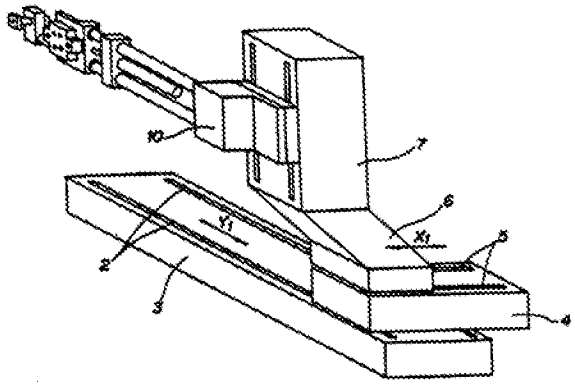

FIG. 5

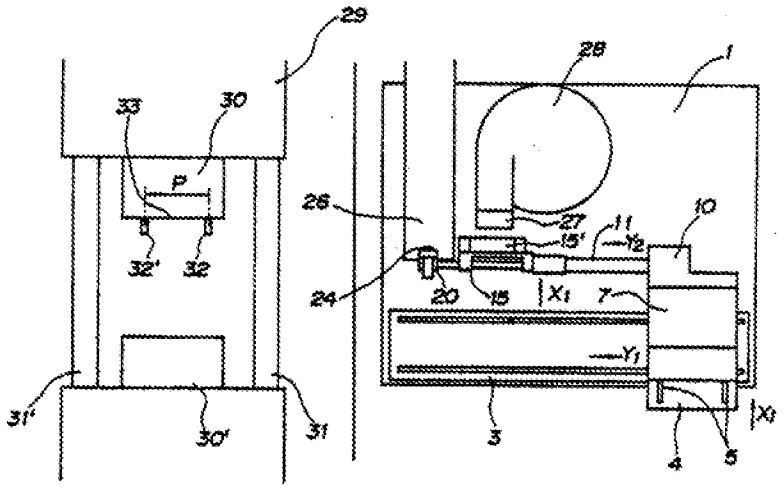

FIG. 6

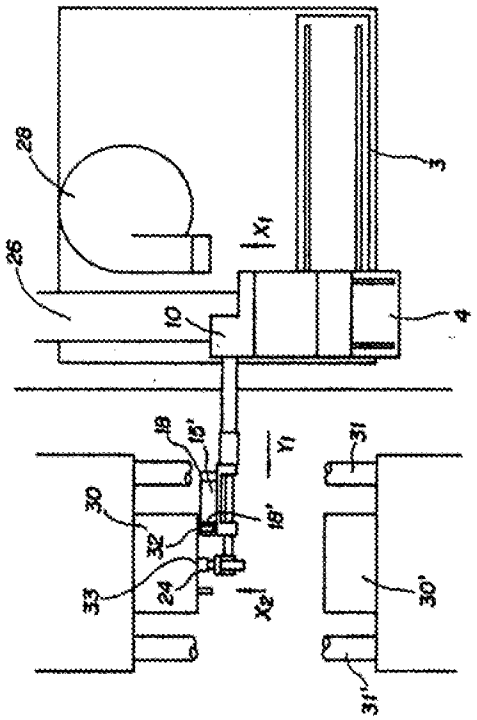

FIG. 7

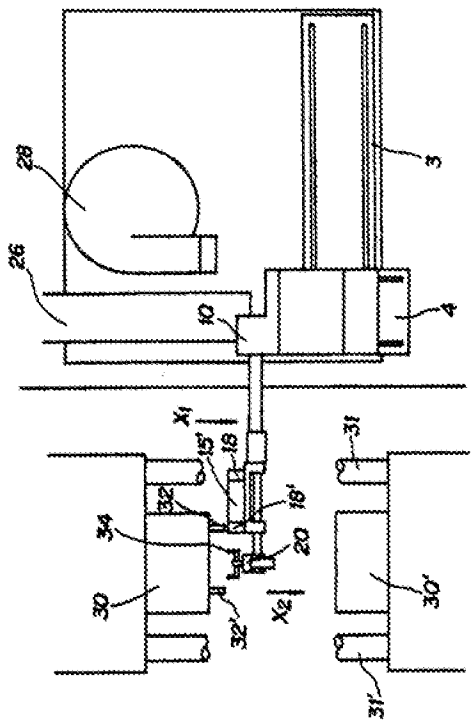

FIG. 8

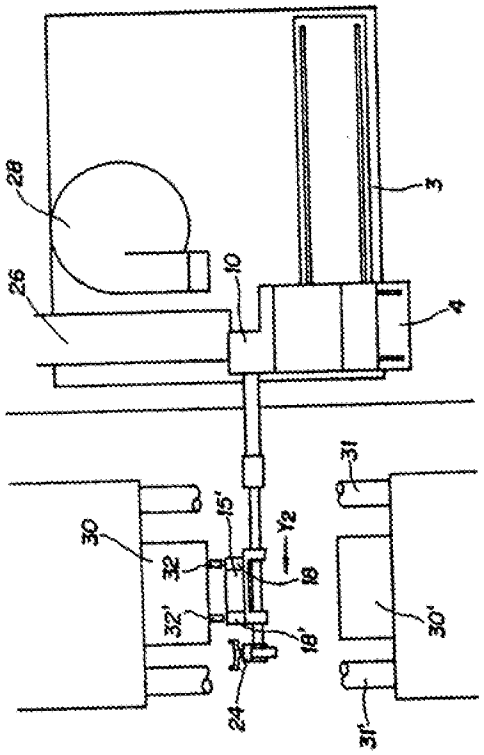

FIG. 9

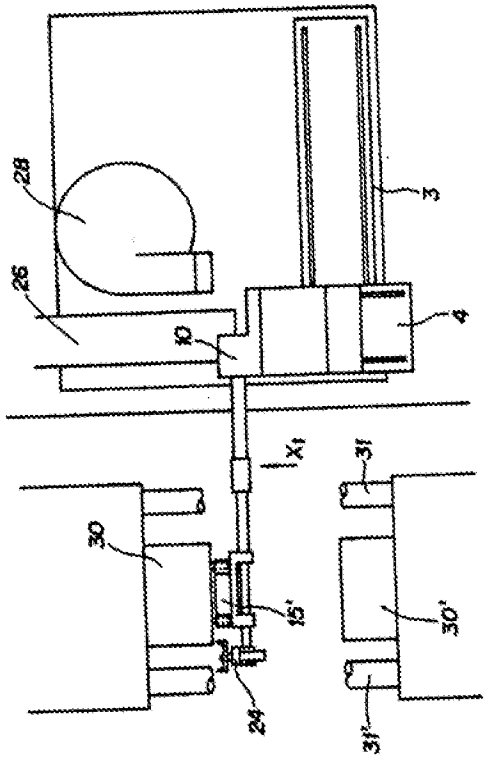

FIG. 10

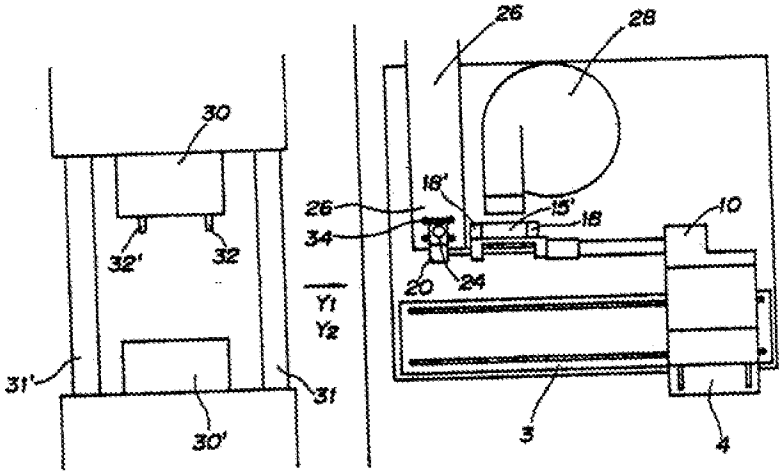

FIG. 11